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TITLE: INK JET HEAD, METHOD FOR INTRODUCING INK TO INK JET HEAD  
AND INTRODUCTION LIQUID

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ABSTRACT:

**PROBLEM TO BE SOLVED:** To derive a sufficient performance of ink by completely removing bubbles in an ink jet head and introducing the ink thereinto and to readily achieve a recorded clear image having a high density.

**SOLUTION:** An introduction liquid 15 is filled into an ink jet head 11 before ink 16 is introduced therein, then the liquid 15 is replaced with the ink 16. The introduction liquid 15 has a viscosity equal to or lower than that of the ink 16 and a surface tension equal to or lower than that of the ink 16. A bubbling property is defined such that a bubble height right after the bubbling at a temperature of 25°C is not higher than 2 mm and a bubble height after five minutes from the bubbling by using a Ross-Miles test. The introduction liquid 15 includes a water and a water-soluble organic solvent having a surfactant property and a low volatility lower than that of water. The introduction liquid 15 is treated such that 90 weight percent of water and 10 weight percent of triethylene glycol monobutyl ether are mixed and agitated, then they are filtered by means of a membrane filter of 0.8  $\mu\text{m}$ .

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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*\*).
2. Texts in the figures are not translated and shown as it is.

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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The ink introduction method to the ink-jet head characterized by providing the following It has the surface tension equivalent [ having the viscosity not more than it ] to this ink, or not more than [ equivalent to this ink, before introducing ink, or ] it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after at 25 degrees C using the Roth Miles method, and it is water. It has surface activity ability and is the water-soluble organic solvent of low volatility [ water ].

[Claim 2] The ink introduction method to the ink-jet head according to claim 1 characterized by the steam pressure at 20 degrees C containing polyhydric alcohol alkyl ether of 0.1 or less mmHg as a water-soluble organic solvent of low volatility which has this surface activity ability.

[Claim 3] The ink introduction method to the ink-jet head according to claim 2 characterized by the steam pressure at 20 degrees C of this polyhydric alcohol alkyl ether being less than 0.01 mmHg.

[Claim 4] The ink-jet head which is characterized by providing the following and which breathes out ink and performs record operation It has equivalent to this ink, or equivalent [ having the viscosity not more than it ] to this ink, or the surface tension not more than it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after at 25 degrees C using the Roth Miles method, and it is water. It has surface activity ability and is the water-soluble organic solvent of low volatility [ water ].

[Claim 5] The ink-jet head according to claim 4 characterized by the steam pressure at 20 degrees C containing polyhydric alcohol alkyl ether of 0.1 or less mmHg as a water-soluble organic solvent of low volatility which has this surface activity ability.

[Claim 6] The ink-jet head according to claim 5 characterized by the steam pressure at 20 degrees C of this polyhydric alcohol alkyl ether being less than 0.01 mmHg.

[Claim 7] Introductory liquid with which the ink-jet head is filled up before introducing ink to the ink-jet head characterized by providing the following It has equivalent to this ink, or equivalent [ having the viscosity not more than it ] to this ink, or the surface tension not more than it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after at 25

degrees C using the Roth Miles method, and it is water. It has surface activity ability and is the water-soluble organic solvent of low volatility [ water ].

[Claim 8] Introductory liquid according to claim 7 characterized by the steam pressure at 20 degrees C containing polyhydric alcohol alkyl ether of 0.1 or less mmHg as a water-soluble organic solvent of low volatility which has this surface activity ability.

[Claim 9] Introductory liquid according to claim 8 characterized by the steam pressure at 20 degrees C of this polyhydric alcohol alkyl ether being less than 0.01 mmHg.

## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink introduction method and the introductory liquid to an ink-jet head and this ink-jet head.

[0002]

[Description of the Prior Art] The ink-jet record method is, heating the electrostatic suction method, the method of giving mechanical oscillation or displacement to ink using a piezo-electric element, and ink for example. By the various ink discharge methods, such as a method of using the pressure which is made generating air bubbles and is generated at this time, an ink droplet is formed and it records by making these parts or all adhere to recorded materials, such as paper. Development of the aqueous ink which uses water as a main solvent is briskly performed as ink conventionally used for such an ink-jet record method.

[0003] Clogging is not started in ink-jet record in the head point of recording equipment, or an ink duct, but performances, such as that the stable injection is possible and giving the record picture of concentration high enough in a clear color tone, are required of it. In order to satisfy such demand performances, it is a well-known fact that highly efficient ink is required.

[0004] It is common to use water soluble dye as colorant of the aqueous ink for ink-jets. It is because water soluble dye dissolves completely into an ink medium, so it is possible to be hard to carry out clogging of the dye ink in the point of the head of an inkjet printer or an ink duct, and to obtain a high-concentration record thing in a clear color tone. therefore, the ink-jet using water soluble dye as colorant -- city water -- there are many examples of commercial production of sex ink.

[0005] It is necessary to make the state where it was completely filled with ink, without leaving air bubbles in an ink-jet head, in order to demonstrate enough the functionality of such an aqueous ink for ink-jets. If air bubbles remain in an ink-jet head, discharge power will not fully get across to ink, but problems, such as non-discharge and an injection bend, will be caused, and the performance required of ink-jet record will no longer be satisfied.

[0006] Thus, the quality of the ink introduction nature to an ink-jet head is an important element which influences the performance of ink-jet record.

[0007] Conventionally about the ink introduction nature to an ink-jet head, the ink duct in an ink-jet

head is made into the form with few level differences where air bubbles cannot remain easily, or improvement of making it the quality of the material in which ink is easily damp is tried.

[0008]

[Problem(s) to be Solved by the Invention] However, the ink with which it can be satisfied of the demand performance in ink-jet record has high foamability, and there is no example which full removal of air bubbles is [ example ] difficult and is fully demonstrating the performance of ink by ink introduction nature improvement to the ink-jet head by the conventional ink-jet head design.

[0009] This invention is made in order to solve the problem mentioned above, and it aims at offering the ink introduction nature improvement method to the ink-jet head which can fully demonstrate the performance of ink by removing the air bubbles in an ink-jet head completely.

[0010]

[Means for Solving the Problem] In order to attain this purpose, [ the ink introduction method to an ink-jet head according to claim 1 ] It has equivalent to this ink, before introducing ink, or the viscosity not more than it. And it is characterized by equivalent to this ink, or being filled up with the introductory liquid which it has the surface tension not more than it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after at 25 degrees C, has water and surface activity ability using the Roth Miles method, and contains the water-soluble organic solvent of low volatility rather than water.

[0011] Moreover, Claim 4 is concerned with the ink-jet head which breathes out ink and performs record operation. Using the Roth Miles method, at 25 degrees C, have equivalent to this ink, or equivalent [ having the viscosity not more than it ] to this ink, or the surface tension not more than it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after, and Water, It is characterized by being filled up with the introductory liquid which has surface activity ability and contains the water-soluble organic solvent of low volatility rather than water.

[0012] Before [ moreover, ] Claim 7 introduces ink to an ink-jet head It is concerned with the introductory liquid with which the ink-jet head is filled up, and has equivalent to this ink, or the viscosity not more than it. And it is characterized by equivalent to this ink, or for foamability being 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after at 25 degrees C, having water and surface activity ability by having the surface tension not more than it, using the Roth Miles method, and including the water-soluble organic solvent of low volatility rather than water. Each claim introduction liquid is preferably characterized by the steam pressure at 20 degrees C containing polyhydric alcohol alkyl ether of 0.1 or less mmHg as a water-soluble organic solvent of low volatility which has this surface activity ability.

[0013] Furthermore, introductory liquid is preferably characterized by the steam pressure at 20 degrees C of this polyhydric alcohol alkyl ether being less than 0.01 mmHg.

[0014]

[Embodiment of the Invention] The form of operation of this invention is explained hereafter.

[0015] The introductory liquid of this invention makes it possible to be filled up with ink, without leaving

air bubbles in an ink-jet head by being filled up in an ink-jet head, before introducing ink into an ink-jet head, and introducing ink after that. Namely, the introductory liquid of this invention contains the water-soluble organic solvent of low volatility rather than water and water. Compared with the ink to be used for viscosity to be below equivalent and for low surface tension be below equivalent In addition, since foamability is 2mm or less of bubble quantities just behind \*\*\*\* and 0mm of bubble quantities of 5 minutes after, i.e., low foamability, at 25 degrees C using the Roth Miles method, The vapor-liquid substitution in an ink-jet head is possible, without leaving air bubbles easily with the purge equipment provided to ink-jet equipment. [ purge equipment ] where [ in addition, ] the cartridge 12 which builds in ink 16 is conventionally connected to the ink-jet head 11 so that it may be well-known It is what puts cap 13 on the discharge mouth side of the ink-jet head 11, and draws in with a pump 14, or acts positive pressure from the cartridge 12 side, and introduces ink 16 into the ink-jet head 11. In the case of this invention, the introductory liquid 15 filled up with the same operation into the ink-jet head 11 can be replaced by ink 16.

[0016] Once filling this introductory liquid in an ink-jet head Even if moisture evaporates or it discharges this introductory liquid, it has the surface activity ability in this introductory liquid. When the state where the water-soluble organic solvent of low volatility covered the duct wall surface in an ink-jet head is maintained and ink is behind introduced rather than water, in any case, it becomes possible [ introducing without leaving air bubbles easily ]. Although an ink-jet head is in the state with which introductory liquid was filled, is removed from a cartridge 12 or cap 13 and is conveyed independently, it covers the nozzle hole for discharge, and a connection mouth with a cartridge with lids, such as pressure sensitive adhesive tape or rubber, etc., and may be made to lessen a leak and evaporation of introductory liquid.

[0017] As for the water as an ingredient of this introductory liquid in this invention, it is desirable to use deionized water (pure water). Although the content of the water at this time is determined in the large range depending on the characteristic of the introductory liquid for which it asks, it is 65 to 95weight % of within the limits to the full weight of introductory liquid.

[0018] Moreover, as for the water-soluble organic solvent of low volatility which has the surface activity ability as an ingredient of this introductory liquid in this invention, it is desirable for the steam pressure in 20 degrees C to use polyhydric alcohol monoalkyl ether of 0.1 or less mmHg. [ unlike a surface-active agent (for example, polyoxy ethylene NONIRU phenyl ether) with this common polyhydric alcohol monoalkyl ether / the mixed-solution with water ] though it is low foamability It is low surface tension, and since the ink duct wall surface of an ink-jet head is often wet, the vapor-liquid substitution which does not leave air bubbles is attained. Moreover, since this polyhydric alcohol monoalkyl ether is low volatility, In order to remain where the ink duct wall surface of an ink-jet head is wet uniformly even if water is lost by evaporation etc., it is not necessary to carry out vapor-liquid substitution of the ink duct wall surface of an ink-jet head again, and perfect ink introduction becomes possible easily in the case of subsequent ink introduction.

[0019] As an example of the above-mentioned polyhydric alcohol monoalkyl ether For example, diethylene glycol monomethyl ether (steam pressure 0.1mmHg in 20 degrees C), Diethylene glycol

monobutyl ether (steam pressure 0.01mmHg in 20 degrees C), Diethylene glycol MONOISO butyl ether (steam pressure 0.01mmHg in 20 degrees C), Dipropylene glycol monomethyl ether (steam pressure 0.06mmHg in 20 degrees C), Dipropylene glycol monopropyl ether (steam pressure 0.02mmHg in 20 degrees C), Dipropylene glycol mono-isopropyl-ether (steam pressure 0.05mmHg in 20 degrees C), Dipropylene glycol monobutyl ether (steam pressure 0.05mmHg in 20 degrees C), Triethylene glycol monomethyl ether (less than 0.01 mmHg of steam pressure in 20 degrees C), Triethylene glycol monobutyl ether (less than 0.01 mmHg of steam pressure in 20 degrees C), Although tripropylene glycol monomethyl ether (steam pressure 0.02mmHg in 20 degrees C), tripropylene glycol monobutyl ether (less than 0.01 mmHg of steam pressure in 20 degrees C), etc. are mentioned, you may use these independently, It is also possible for two or more sorts to be mixed and to use.

[0020] Furthermore, since the thing of less than 0.01 mmHg has still lower volatility and a bad smell peculiar to polyhydric alcohol alkyl ether does not almost have the steam pressure in 20 degrees C in the above-mentioned polyhydric alcohol alkyl ether, either, it can be used conveniently. As for the content of the above-mentioned polyhydric alcohol alkyl ether in this introductory liquid, 1 to 30 weight % is desirable to the ink whole quantity at weight %. Since residual volume sufficient on the ink duct wall surface of an ink-jet head is not obtained as it is less than 1 weight %, it becomes impossible for subsequent ink introduction nature to say that it is good enough. Moreover, if 30 weight % is exceeded, the viscosity of this introductory liquid may become high and introduction by purge equipment may become difficult.

[0021] Although the basic composition of the introductory liquid of this invention is as above, various well-known water-soluble organic solvents, a viscosity controlling agent, a surface tension regulator, a pH adjuster, an antiseptic and mildewproofing agent, etc. can be added if needed conventionally.

[0022] It is desirable to choose a volatile low solvent like the water-soluble organic solvent of low volatility which has this surface activity ability as this water-soluble organic solvent. As such a water-soluble organic solvent, polyalkylene glycols; ethylene glycol, such as polyethylene glycols, Propylene glycol, butylene glycol, diethylene glycol, A dipropylene glycol, triethylene glycol, tripropylene glycol, Alkylene glycol, such as 1, 2, 6-HEKISAN triol, a CHIOJI glycol, 1, 3-butanediol, 1,5-pentanediol, and hexylene glycol; pylori bosses, such as a glycerin;2-pylori boss and an N-\*\*\*\*\*- 2-pylori boss, are mentioned. It is also possible to use these water-soluble organic solvents independently, and for two or more kinds to be mixed and to use.

[0023] The content of the above-mentioned water-soluble organic solvent in this introductory liquid is 0 to 30 weight % in weight % to the introductory liquid whole quantity. However, in order to maintain viscosity at hypoviscosity, it may be necessary to be 30 or less weight % in the sum total with the water-soluble organic solvent of low volatility which has this surface activity ability.

[0024] Moreover, it is better not to add colorant, such as water soluble dye, fundamentally in the introductory liquid of this invention. If these colorant is mixed so much, foamability will become high and the effect of this invention will not be acquired. However, if it is the range which does not spoil the effect of this invention, it is also possible to add in small quantities in order to acquire visibility.

[0025] The problem of the conventional technology is fully solved, and the ink introduction nature improvement method to the ink-jet head of this invention obtained as mentioned above can perform perfect ink introduction easily, and enables realization of the outstanding stable injection performance in ink-jet record, and the outstanding record.

[0026]

[Example] The example which materialized this invention is explained hereafter.

[0027] In addition, there is a weight standard with a sentence and % in front. The example 1-3 of introductory liquid and the example 1-4 of comparison liquid of this invention were prepared as shown in Table 1.

[0028]

[Table 1]

	液組成						
	導入液 例1	導入液 例2	導入液 例3	比較液 例1	比較液 例2	比較液 例3	比較液 例4
水	80%	76%	72%	100%	76%	60%	75.9%
TEGBE	10%	4%	8%			40%	
DEGBE							0.1%
POENFE		20%	10%		24%		24%
GLY			10%				
2P			10%				
計	100%	100%	100%	100%	100%	100%	100%
粘度(cPa)	1.5	2.3	2.7	1.0	2.2	4.5	2.3
表面張力(mN/m)	35	39	33	72	66	31	33

TEGBE: トリエチレングリコールモノブチルエーテル  
 DEGBE: ジエチレングリコールモノブチルエーテル  
 POENFE: ポリオキシエチレンノニルフェニルエーテル(オキシエチレン鎖数11)  
 GLY: グリセリン  
 2P: 2-ピロリドン

Liquid composition of Table 1 was prepared by filtering with a 0.8-micrometer membrane filter, after fully carrying out mixed churning of each material.

[0029] The example 1-4 for ink-jets of ink was prepared as shown in Table 2.

[0030]

[Table 2]

	インクジェット用インク			
	例1	例2	例3	例4
水	66%	67%	66%	66%
DEGBE	4%	4%	4%	4%
GLY	28%	28%	28%	28%
FBK2	2%			
DY132		1%		
DR227			2%	
DB199				2%
計	100%	100%	100%	100%
粘度(cPa)	3.1	3.0	3.1	3.2
表面張力(mN/m)	40	41	41	39

DEGBE: ジエチレングリコールモノブチルエーテル  
 GLY: グリセリン  
 FBK2: カラーインデックスナンバーフードブラック2  
 DY132: カラーインデックスナンバーダイレクトイエロー132  
 DR227: カラーインデックスナンバーダイレクトレッド227  
 DB199: カラーインデックスナンバーダイレクトブルー199



Each ink for ink-jets of Table 2 was prepared by filtering with a 0.8-micrometer membrane filter, after fully carrying out mixed churning of each material.

Give thermal energy to the ink in a <example 1> recording head, and a drop is generated. The multi-head of the type on demand which records ([ 35 micrometers of diameters of a discharge orifice ]) The recording equipment which has the exothermic resistance bulk resistance value of 150 ohms, the drive voltage of 30v, and the frequency of 2kHz, And give the pressure by piezo-electric element vibration to the ink in a recording head, and a drop is generated. Purge equipment which possesses example of introductory liquid 1 at this recording equipment in the recording equipment which has the multi-head (40 micrometers of diameters of a discharge orifice, drive voltage of 30v, frequency of 10kHz) of the type on demand which records When it introduced and the following test evaluations were performed, the good result was obtained also in any.

[0031] (Test evaluation 1) Although the example 1-4 for ink-jets of ink was introduced into said recording equipment in the state where it was filled up with introductory liquid, with purge equipment and continuation discharge of 48 hours was performed under atmosphere (room temperature, 5 degrees C, and 40 degrees C), respectively, quality record stabilized from beginning to end also on condition of any was able to be performed.

[0032] (Test evaluation 2) Although introductory liquid was once discharged with purge equipment from said recording equipment after being filled up with introductory liquid, the example 1-4 for ink-jets of ink was introduced after the room temperature neglect for one month and intermittent injection of the continuation discharge of 48 hours and a 2-minute interval was performed under atmosphere (room temperature, 5 degrees C, and 40 degrees C), respectively, Quality record stabilized from beginning to end also on condition of any was able to be performed.

[0033] When example of introductory liquid 2 was introduced into recording equipment like the <example 2> example 1 and the test evaluation 1 and 2 were performed, also in any, the same result as an example 1 of having excelled was shown.

[0034] When example of introductory liquid 3 was introduced into recording equipment like the <example 3> example 1 and the test evaluation 1 and 2 were performed, also in any, the same result as an example 1 of having excelled was shown.

[0035] When example of comparison liquid 1 was introduced into recording equipment like the <comparative example 1> example 1 and the test evaluation 1 and 2 were performed, in the test evaluation 1, the injection bend and temporary non-discharge by which air bubbles are considered to be the cause were observed. Moreover, still more remarkable unstable injection was observed in the test evaluation 2. Moreover, the record picture obtained by each test evaluation was what lacks in concentration and clear nature with many dot omissions and impact gaps.

[0036] When example of comparison liquid 2 was introduced into recording equipment like the <comparative example 2> example 1 and the test evaluation 1 and 2 were performed, the test evaluation 1, the injection bend by which air bubbles are considered to be the cause for 2, and temporary non-discharge were observed. Moreover, the record picture obtained by each test evaluation was what lacks in concentration and clear nature with many dot omissions and impact

gaps.

[0037] When example of comparison liquid 3 was introduced into recording equipment like the <comparative example 3> example 1 and the test evaluation 1 and 2 were performed, the test evaluation 1, the injection bend by which air bubbles are considered to be the cause for 2, and temporary non-discharge were observed. Moreover, the record picture obtained by each test evaluation was what lacks in concentration and clear nature with many dot omissions and impact gaps.

[0038] When example of comparison liquid 4 was introduced into recording equipment like the <comparative example 4> example 1 and the test evaluation 1 and 2 were performed, the test evaluation 1, the injection bend by which air bubbles are considered to be the cause for 2, and non-discharge were observed frequently, and injection of some nozzles became completely impossible. Moreover, the record picture obtained by each test evaluation had very many dot omissions and impact gaps, and was what lacks in concentration or clear nature greatly.

[0039] The good result was not obtained, although no <comparative example 5> introduction liquid was used but the following test evaluations 3 were performed.

[0040] (Test evaluation 3) It is purge equipment about the example 1-4 for ink-jets of ink to recording equipment. Although it introduced and continuation discharge of 48 hours was performed under atmosphere (room temperature, 5 degrees C, and 40 degrees C), respectively, the record picture which the injection bend and temporary non-discharge by which air bubbles are considered to be the cause were observed frequently, and was obtained by test evaluation was what lacks in concentration and clear nature with many dot omissions and impact gaps.

[0041] The test evaluation 1 about the above example and a comparative example and the result of 2 and 3 are shown in Table 3.

[0042]

[Table 3]

	試験評価		
	1	2	3
実施例1	◎	◎	...
実施例2	◎	◎	...
実施例3	◎	○	...
比較例1	△	×	...
比較例2	△	△	...
比較例3	△	△	...
比較例4	×	×	...
比較例5	...	...	×

◎: 優良

○: 良

△: 不良

×: 劣悪

...: 実施せず

As mentioned above, according to the example of this invention, by removing the air bubbles in an ink-jet head completely, the stable injection in ink-jet record is attained, and a clear record picture can

be easily obtained by high concentration. On the other hand in the comparative example, it has a problem in either of the test evaluations.

[0043]

[Effect of the Invention] It has equivalent [ like / it is \*\*\*\*\* from having explained above and ] to this ink according to this invention, before introducing ink, or the viscosity not more than it. Using the Roth Miles method, at 25 degrees C, have equivalent to this ink, or the surface tension not more than it, and foamability is 2mm or less of bubble quantities just behind \*\*\*\*, and 0mm of bubble quantities of 5 minutes after, and And water, As a water-soluble organic solvent of low volatility which is characterized by being filled up with the introductory liquid which has surface activity ability and contains the water-soluble organic solvent of low volatility rather than water, and has this surface activity ability Since it is characterized by the steam pressure at 20 degrees C containing polyhydric alcohol alkyl ether of 0.1 or less mmHg and is characterized by the steam pressure at 20 degrees C of this polyhydric alcohol alkyl ether being less than 0.01 mmHg By removing the air bubbles in an ink-jet head completely, it becomes it is possible to fully demonstrate the performance of ink and possible to obtain a clear record picture easily by high concentration.

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[Translation done.]